Standoff Ultra-Compact Raman (SUCR) system Development for faster daytime mineralogy and Raman Imaging

Completed Technology Project (2015 - 2018)

Project Introduction

Raman spectroscopy can positively identify organic molecules, biomarkers, biominerals, water, water containing minerals, and minerals that are of high interest to NASA and directly serve the goal of finding evidence for past life on Mars and other planets. Micro-Raman systems are capable of performing fine-scale mineralogy; hence, they are being actively proposed as instruments on planetary rovers for in situ analysis. A micro-Raman system, Raman Laser Spectrometer (RLS), developed by Centro de Astrobiología, Unidad Asociada (CSIC-UVA), Spain is one of the Pasteur Payload instruments on board the ESA ExoMars rover to be launched in 2018. Similarly, JPL and Washington University in St. Louis, have developed a micro-Raman system, Mars Microbeam Raman Spectrometer (MMRS) with funding from NASA. The RLS and MMRS are severely limited in their performance because (1) they require sample collection, (2) cannot be operated under daytime conditions, (3) provide poor Raman capabilities in presence of fluorescence, (4) cannot separate the highly desirable bio-florescence signal from unwanted mineral fluorescence signal, and (5) are too slow (1 to 60 s/spectrum). No Raman images will be expected from these systems due to these limitations. These disadvantages are due to the implementation of traditional Raman technology that is designed for dark laboratory use. These limitations will significantly lower the science return from these micro-Raman systems in terms of number and variety of samples that can be analyzed on Mars. Under this proposal, we propose to develop a new "Standoff Ultra-Compact Raman" (SUCR) instrument in collaboration with University of Hawaii which will solve all of the limitations listed above with the RLS and MMRS instruments. SUCR provides a superior micro-Raman instrument for future NASA missions. The development of SUCR will require improvements in both remote Raman and ultra-compact Raman technologies and the implementation of line imaging for faster Raman context imaging and map collection. The SUCR system will be able to quickly collect (1 s/spectrum) high quality in situ Raman spectral images in the daytime, from distances of several centimeters, with no need for samples collection. For example, the SUCR instrument will allow for fine scale context mineralogy of drilled cores, layer structures, and trenches. In addition, SUCR will be able to detect any micron size biomarker in situ with its faster search and scan mode (0.1s). Under this project, the TRL of the proposed SUCR instrument will advance from TRL 1 to TRL 3.

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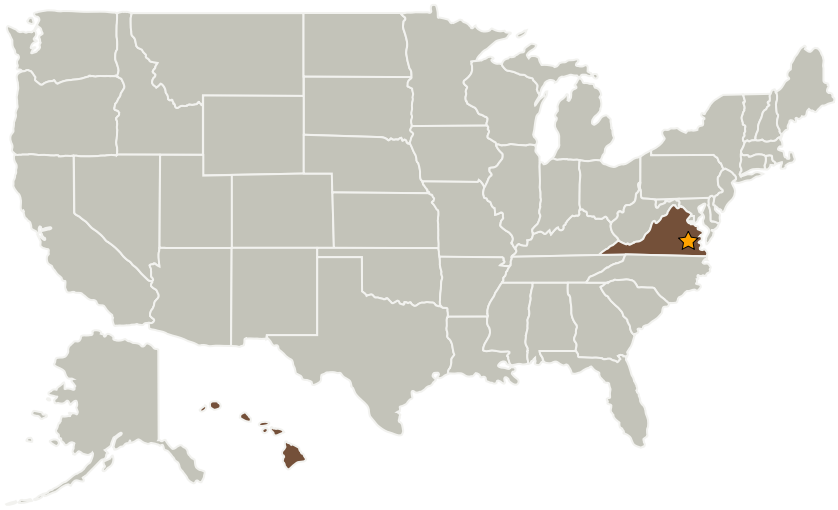
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Langley Research Center(LaRC)	Lead Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Hawaii	Virginia

Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Lead Center / Facility:

Langley Research Center (LaRC)

Responsible Program:

Planetary Instrument Concepts for the Advancement of Solar System Observations

Project Management

Program Director:

Carolyn R Mercer

Program Manager:

Haris Riris

Principal Investigator:

M N Abedin

Co-Investigators:

Anupam K Misra
Rebecca W Bales
Arthur T Bradley
James F Osmundsen
Shiv K Sharma

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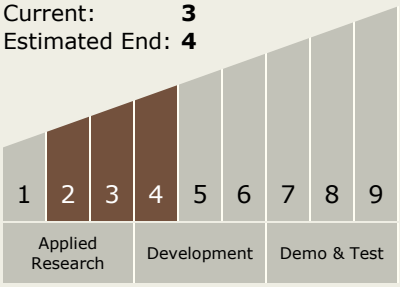
Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **4**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

Target Destination

Others Inside the Solar System